

AUGUST 2019



**WIM #32
US 52, MP 66.0
ORONOCO, MN**

**MONTHLY
REPORT**



Your Destination...Our Priority



WIM Site Location

WIM #32 is located on US 52 near Oronoco in Olmsted county.

System Operation

WIM #32 was operational for the entire month of August 2019. Volume was computed using all monthly data.

System Calibration

WIM #32 was most recently calibrated on 2019-06-06. Table 1 summarizes the front axle weights of class 9s by lane ¹. Figure 1 shows the distribution of gross vehicle weights (GVW) in Class 9 vehicles at this site for the last 12 months of operation ². Figure 2 depicts the average front axle weight as a percent difference from the first full month following calibration.

Summary of Volume Statistics

Total Monthly Volume: 1096548 | Passenger Vehicles: 1012139 | Heavy Commercial Vehicles: 84409

Monthly Average Daily Traffic (MADT): 35208 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 2723

See Table 2 for vehicle class breakdown

Passenger Vehicles (PVs) and Heavy Commercial Vehicles (HCVs)

Volume trends. NB vehicles typically reached highest volume levels on Fridays, with lowest volumes reported on Mondays. SB vehicles typically reached highest volume levels on Fridays, with lowest volumes reported on Mondays (see Figure 3 and 4).

Passenger Vehicles (PVs)

Volume trends. On an average 24-hour day (see Figure 5), NB PVs generally reached peak volume levels between 03 PM and 05 PM. Similarly, SB PVs peaked in volume between 03 PM and 05 PM

Heavy Commercial Vehicles (HCVs)

Volume trends. On an average 24-hour day, HCVs traveling NB typically reached peak volume levels between 03 PM and 05 PM, while volume going SB peaked between 03 PM and 05 PM. See Figure 6. Out of all HCVs, the two highest traffic volumes were generated by Class 9's and Class 5's.

Overweight HCVs

Volume trends. Of a total of 84409 HCVs, 11621 of them were overweight ³. These overweight HCVs contributed to 1.1% of total monthly volume, and 14.1% of total monthly

HCV volume. NB overweight vehicles typically reached highest numbers on Wednesdays, with lowest volumes reported on Saturdays. SB overweight vehicles tended to reach highest volumes on Tuesdays, with lowest volumes reported on Sundays. See Figure 3 . The top two overweight violators by class were the class 9 and class 10 vehicles . Overall, overweight vehicles tended to reach peak volume concentrations during typical business hours, with 54% of all overweight vehicles traveling SB this month (see Figure 7 & 8). Figure 9 shows the number of vehicles exceeding 88,000 pounds that crossed the WIM over the last 12 months. The highest number of 88,000+ vehicles within the last 12 months occurred in June.

WIMs are currently used as a screening tool for weight enforcement, and it is estimated that the WIM scales can measure gross vehicle weights (GVW) within 90-95% of static weight scale measurements. Due to the possibility of measurement error, vehicles exceeding 10% of their legal weight limits (or 1.1 times their legal weight limits) are considered overweight in this report ⁴.

Using normal load limits ,206 NB vehicles exceeded 88,000 pounds (78 vehicles were Class 9's; 66 vehicles were Class 13's). Of vehicles traveling SB,

379 NB vehicles exceeded 88,000 pounds (225 vehicles were Class 9's; 82 vehicles were Class 13's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from August 2019.

Loaded vs. Unloaded HCVs. Figure 10 shows the GVW distributions of Class 9s and 10s in August 2019. Data suggests that there were greater numbers of fully_loaded Class 9's than empty Class 9's traveling NB, while there were more fully_loaded Class 9's than empty traveling SB. Data also suggests that there were more fully_loaded Class 10's than empty traveling in the NB direction. In the SB direction, there were more fully_loaded class 10 vehicles.

Freight Totals. A total of 737201 tons of freight was recorded to have crossed the WIM. More freight was shipped SB (50.7%) than NB (49.3%). See Table 4 and Figure 11 for more freight information.

####Infrastructure Considerations Bridge. Bridge No. 55X13 (a box culvert) is approximately 1/3 of a mile north of WIM #32, and Bridge No. 8960 (a box culvert) is approximately 1 ¾ miles south of WIM #32. WIM #32 recorded a total of 1096548 vehicles with a combined GVW of 8164962 kips (1 kip = 1,000 pounds = 0.5 tons) in August 2019. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 67774 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 52.1% of all ESALs were recorded SB while 47.9% was observed NB. In particular, 78% of all ESALs were generated by the Class 9's (Class 9's were also responsible for generating 33% of total GVW observed this month). See Table 6 and Figures 14-15 for more information on ESALs (Table 6 also provides flexible ESAL factors for each vehicle class using a terminal serviceability of 2.5 and a structural number of 5).

#####WIM monthly reports can be found at:

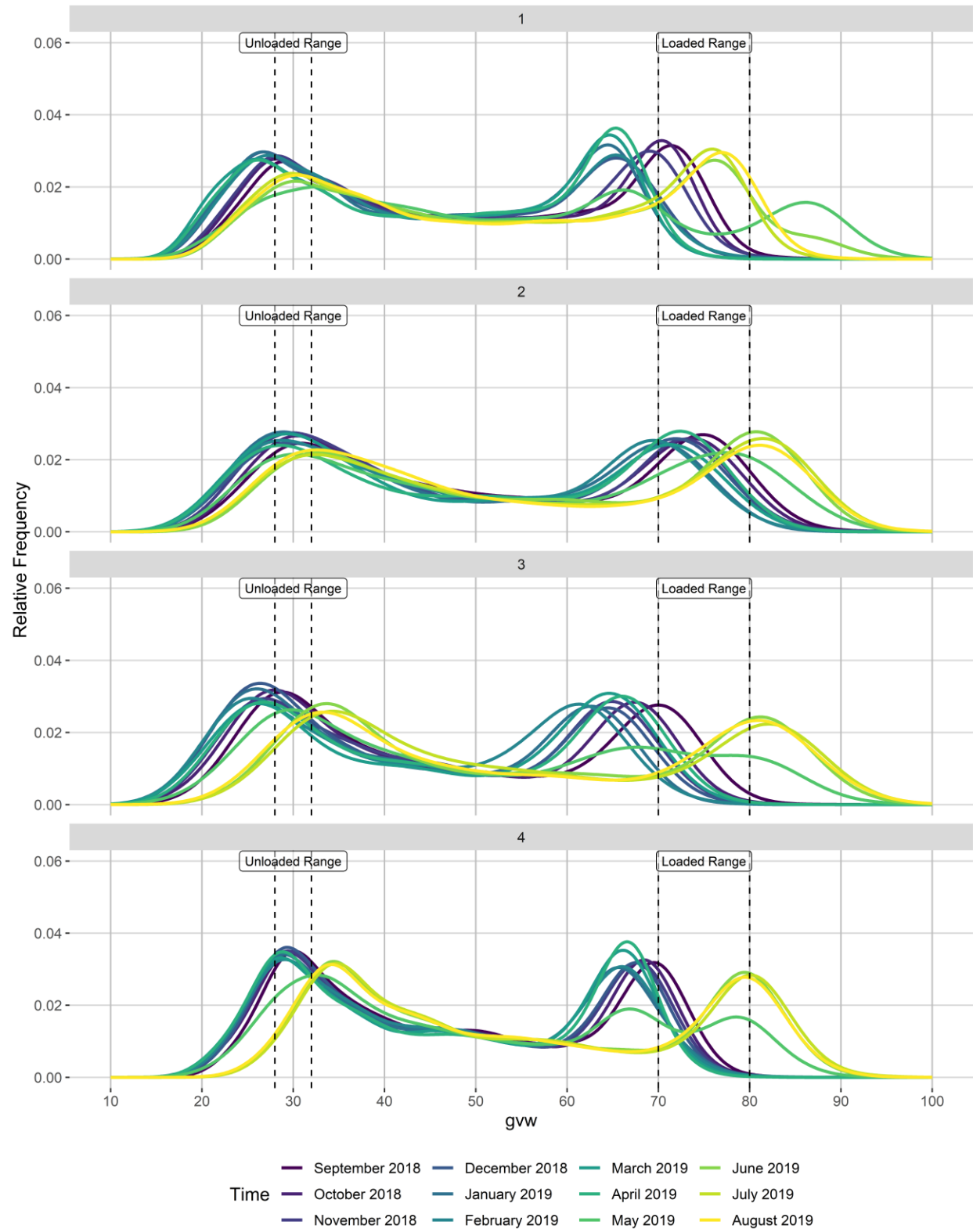
<http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html> MnDOT's vehicle

classification scheme and vehicle class groupings for traffic forecasting can be found at:
<http://www.dot.state.mn.us/traffic/data/data-products.html#weight>

- ¹ Front axle weights of Class 9s are monitored on a monthly basis to assure performance between calibrations. The current goal of the WIM scale calibration is to have each individual axle weight stay within a range of ±9% of baseline calibration values
- ² Previous WIM research indicates that unloaded Class 9s typically weigh 28-32 kips, while loaded Class 9s generally fall in the 70-80 kip range. More recent data from several WIM sites suggests that the unloaded Class 9 range may have moved a little higher over time (due to increased presence of sleeper cabs, etc.), although these ranges are also thought to be site-specific.
- ³ An HCV is considered overweight during normal load limits in this report if they satisfy any of the following 1) exceed a gross vehicle weight (GVW) of 80,000 pounds, 2) exceed any of the legal weight maximums on any axle configurations (legal maximums are: single axle = 20,000 pounds; tandem axles spaced 8' or less = 34,000 pounds; tridem axles spaced 9' or less = 43,000 pounds; quad axles spaced 13' or less = 51,000 pounds). Monthly reports use this standard regardless of the time of year however, the Winter Load Increase (WLI) allows a 10% across the board increase in axle and gross vehicle weights without a permit on US, state routes, and county roads. An HCV is considered overweight during Winter Load Increase(WLI) if they satisfy any of the following 1) exceed a gross vehicle weight (GVW) of 88,000 pounds, 2) exceed any of the legal weight maximums on any axle configurations (legal maximums are: single axle = 22,000 pounds; tandem axles spaced 8' or less = 37,400 pounds; tridem axles spaced 9' or less = 47,300 pounds; quad axles spaced 13' or less = 56,100 pounds). An overweight HCV is only included once in the overweight volume calculations regardless of how many of the aforementioned conditions are violated. For information on MN weight limit dates and statutes:
http://www.mrr.dot.state.mn.us/research/seasonal_load_limits/sllindex.asp
- ⁴ For example, Class 9s and 10s can legally have gross vehicle weights up to 80,000 lbs (with the exception of permitted loads) during normal load limits. To account for measurement error on the WIM scales, those exceeding 10% of the legal GVW maximum (or 1.1 times the legal GVW) should be screened (e.g., 80,000 lbs + 8,000 lbs = 88,000 lbs). Similarly during WLI vehicles weighing 96,800 lbs should be screened.

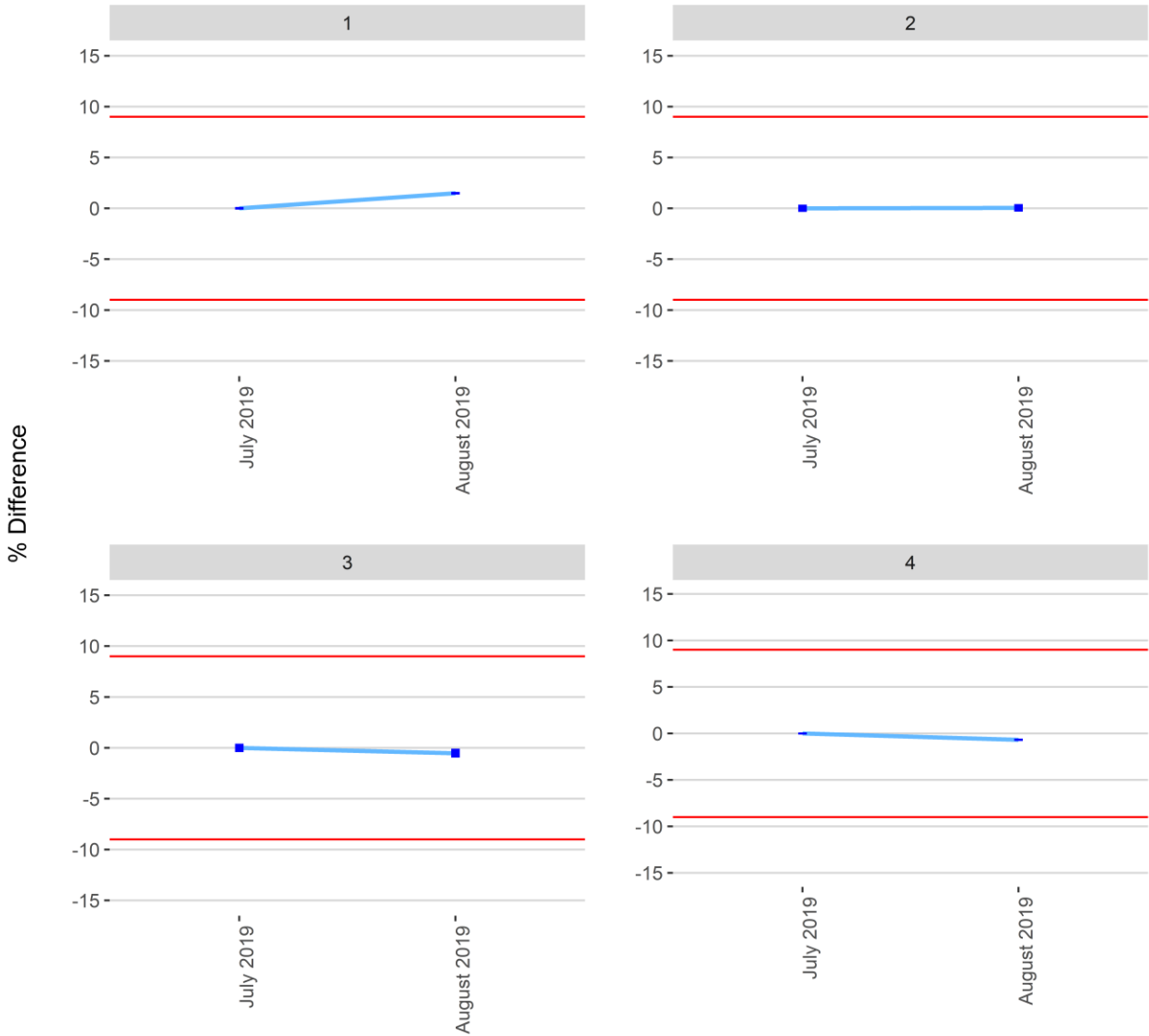
To request this document in an alternative format, please call 651-366-4718 or 1-800-657-3774, or email your request to ADArequest.dot@state.mn.us. Please request at least one week in advance.

Figure 1 - Monthly Class 9 GVW Histogram



Months that have not passed QC parameters are not displayed

Figure 2 - Percent Difference of Front Axle Weight from
Last Calibration (+/- 95% CI)



Months that have not passed QC parameters are not displayed

Figure 2 - Average Vehicle Volume
vs. Day of the Week

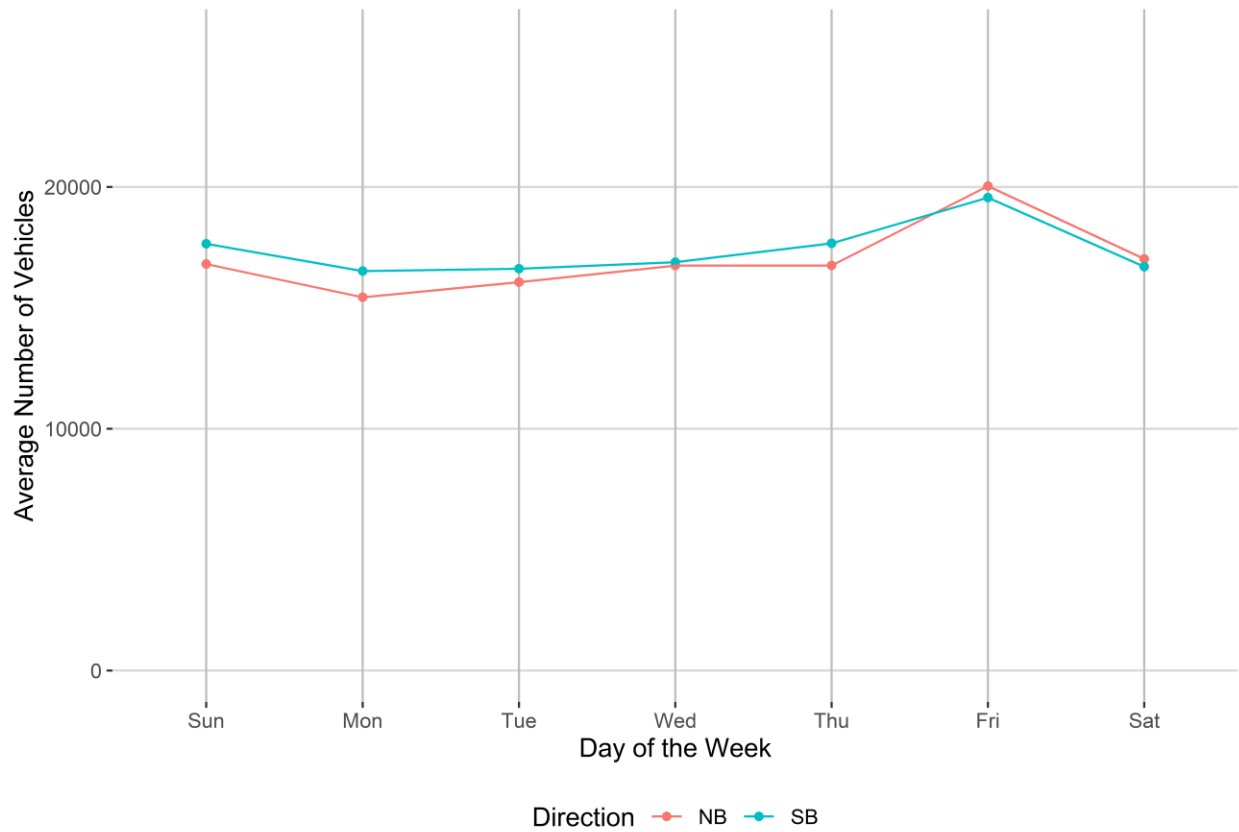


Figure 3 - Average Overweight Vehicle Volume
vs. Day of the Week

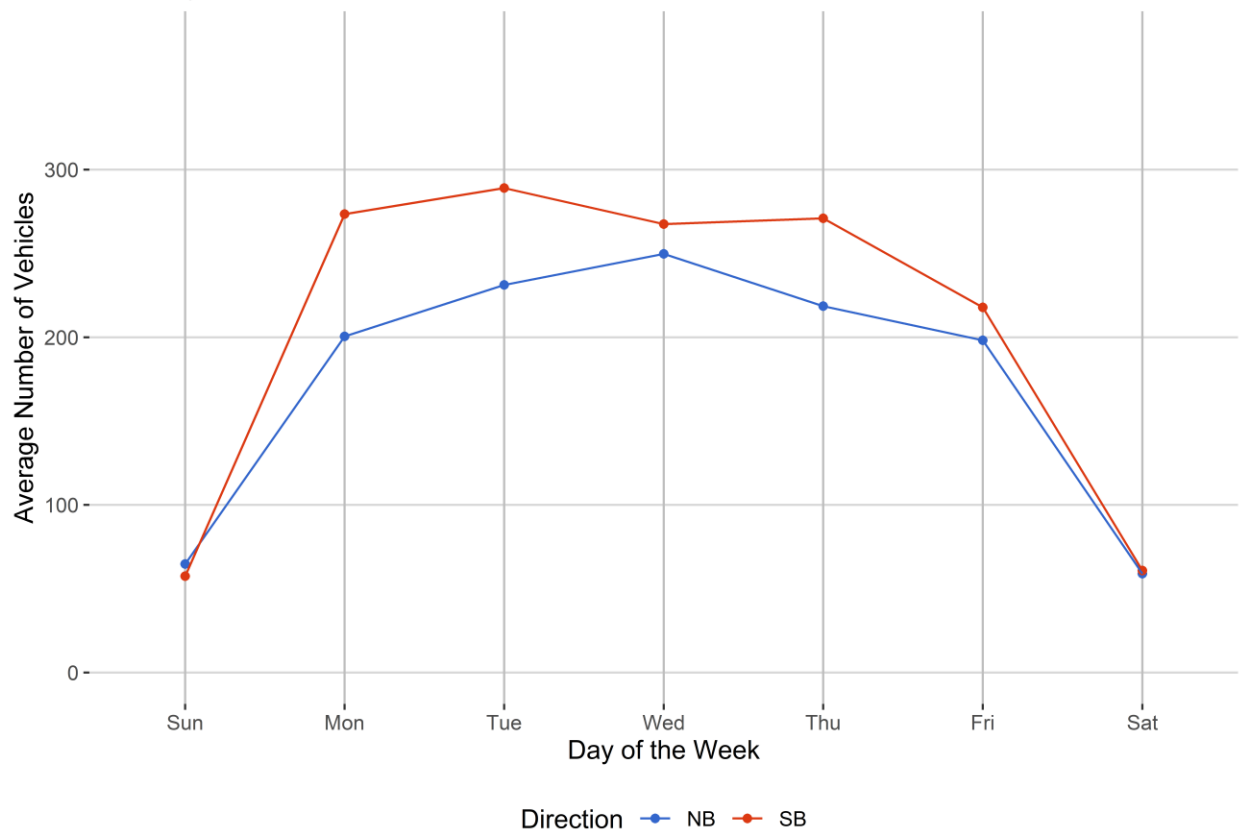


Figure 4 - Passenger Vehicles
vs. Hour of the Day

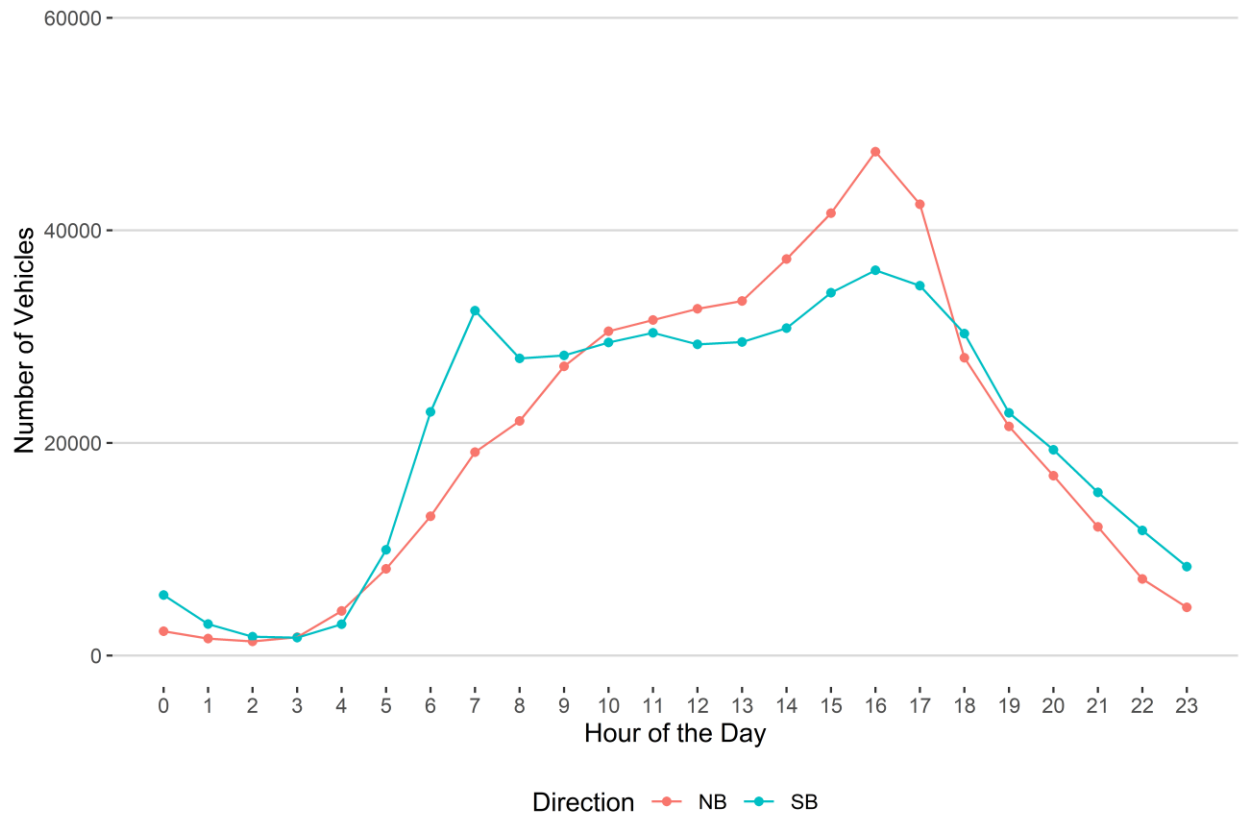


Figure 5 - Heavy Commercial Vehicles
vs. Hour of the Day

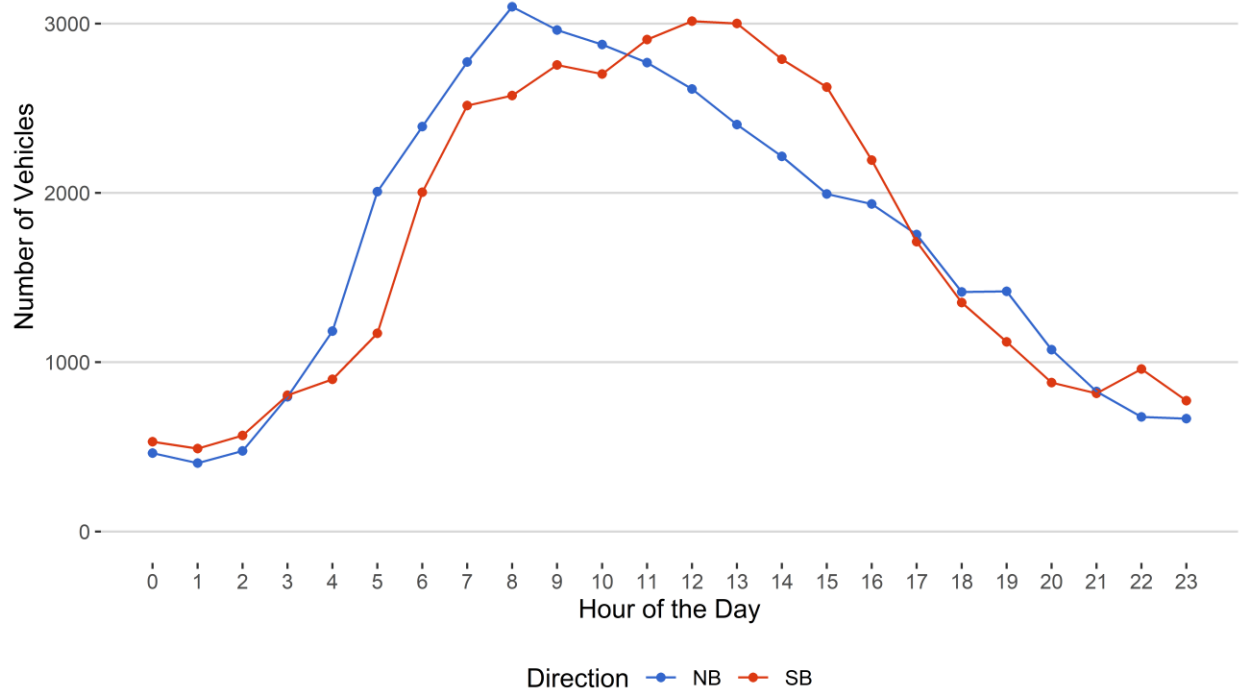


Figure 6 - Overweight Vehicles by Class
vs. Hour of the Day

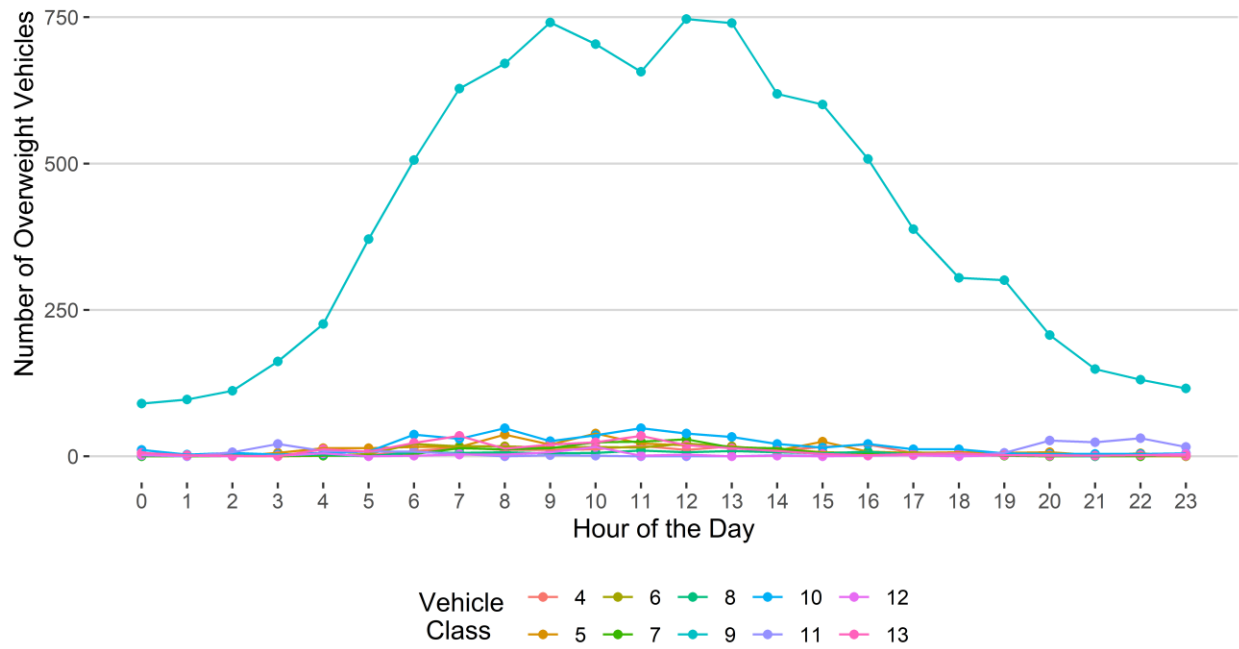


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

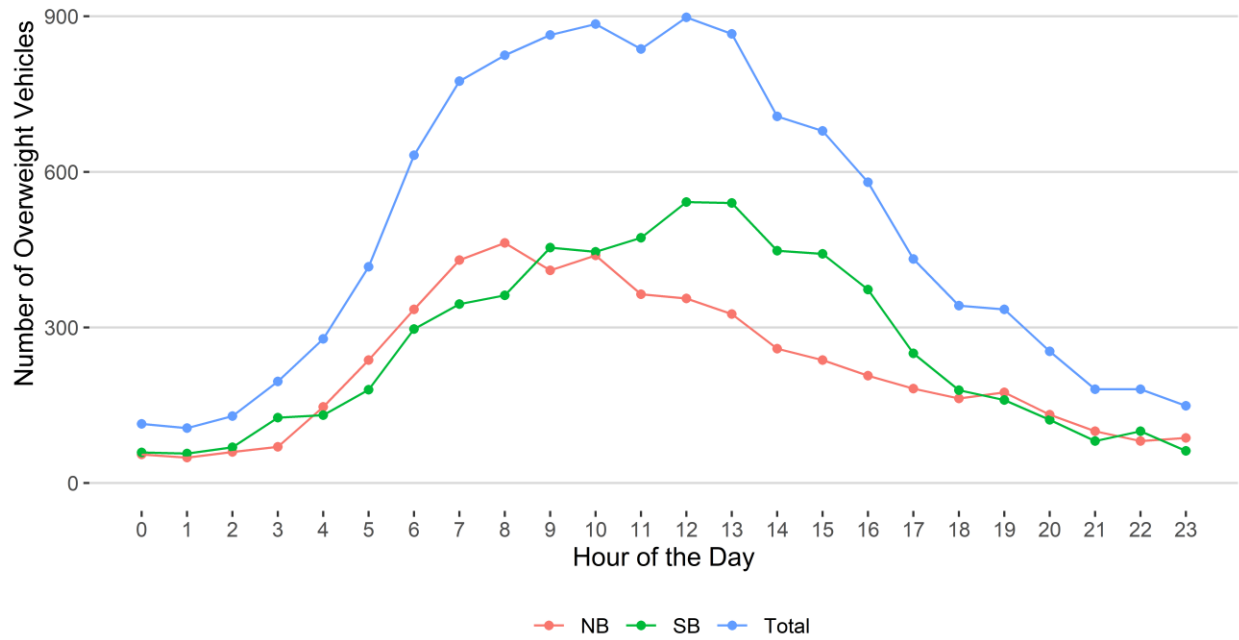
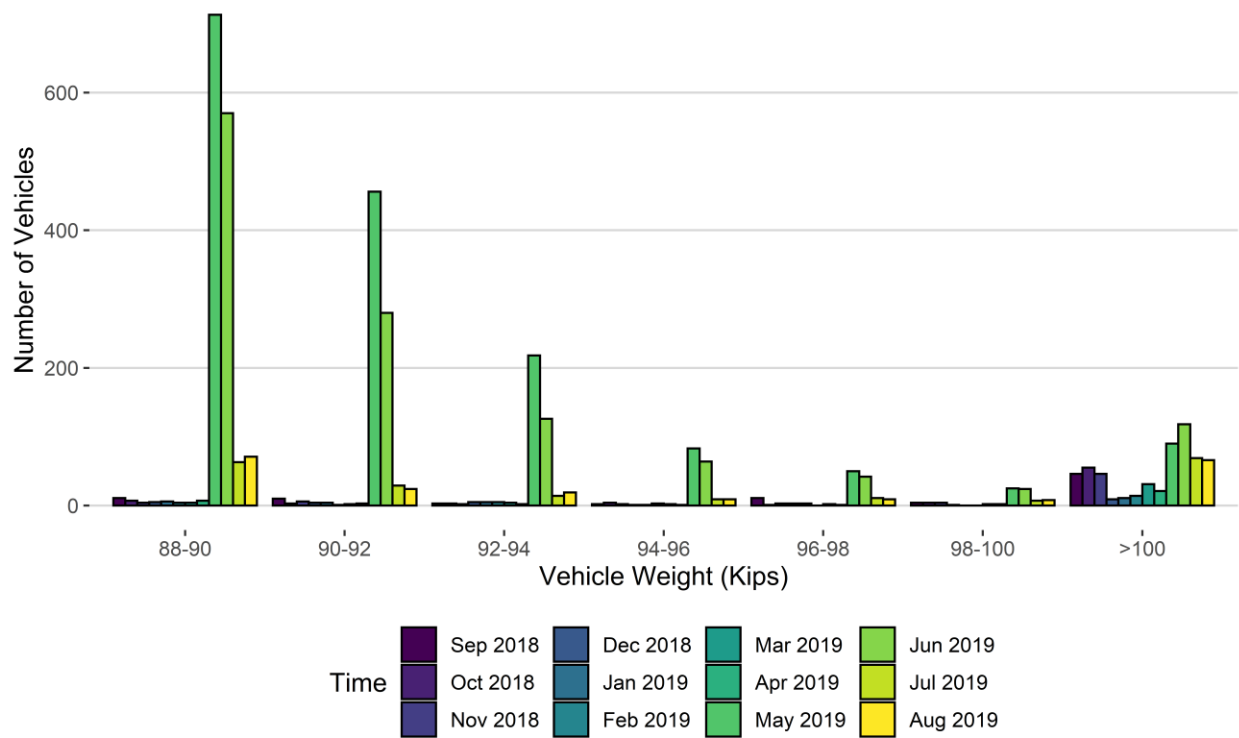
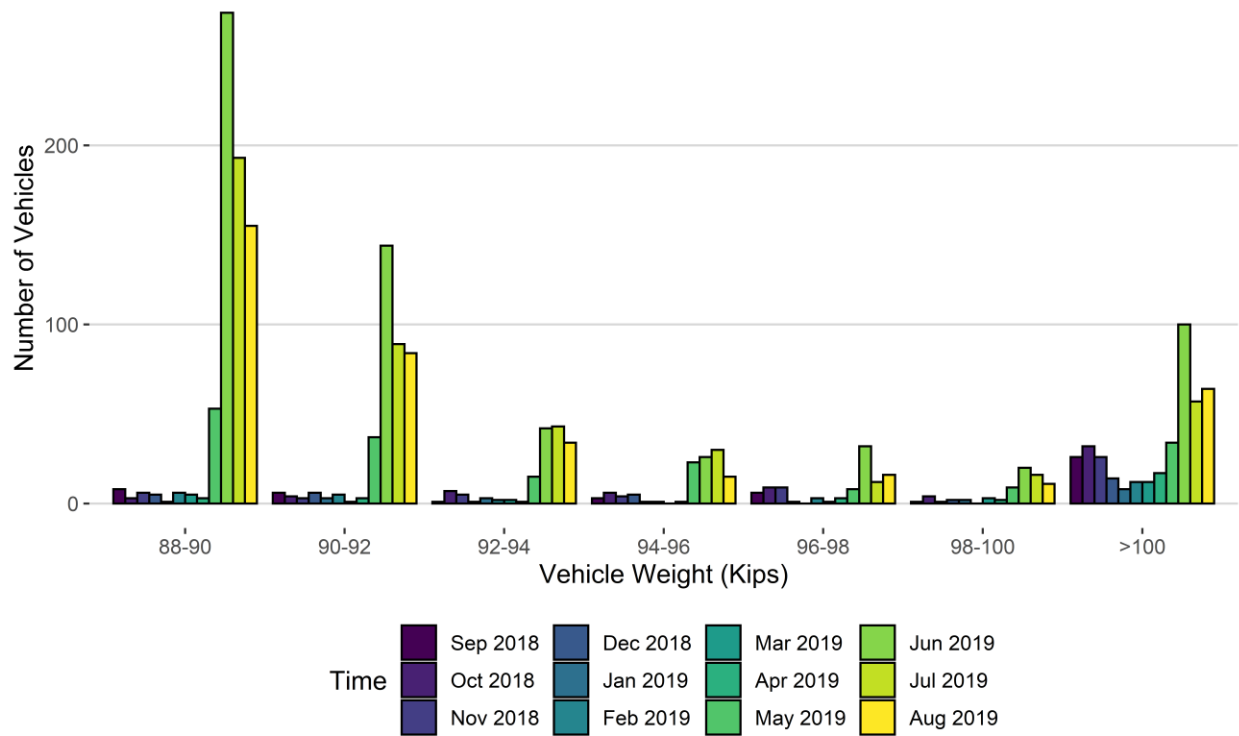


Figure 8 - Histogram of NB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Sep 2018	Oct 2018	Nov 2018	Dec 2018	Jan 2019	Feb 2019	Mar 2019	Apr 2019	May 2019	Jun 2019	Jul 2019	Aug 2019
88-90	11	7	4	5	6	4	4	7	713	570	63	71
90-92	10	3	6	4	4	1	2	3	456	280	29	24
92-94	3	3	2	5	5	5	4	2	218	126	14	19
94-96	2	4	2	1	1	3	2	1	83	64	9	9
96-98	11	1	3	3	3	0	2	1	50	42	11	9
98-100	4	4	4	1	0	0	2	2	25	24	7	8
>100	46	55	46	9	11	14	31	21	90	118	69	66
Total	87	77	67	28	30	27	47	37	1635	1224	202	206

Figure 8 - Histogram of SB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Sep 2018	Oct 2018	Nov 2018	Dec 2018	Jan 2019	Feb 2019	Mar 2019	Apr 2019	May 2019	Jun 2019	Jul 2019	Aug 2019
88-90	8	3	6	5	1	6	5	3	53	274	193	155
90-92	6	4	3	6	3	5	1	3	37	144	89	84
92-94	1	7	5	1	3	2	2	1	15	42	43	34
94-96	3	6	4	5	1	1	0	1	23	26	30	15
96-98	6	9	9	1	0	3	1	3	8	32	12	16
98-100	1	4	1	2	2	0	3	2	9	20	16	11
>100	26	32	26	14	8	12	12	17	34	100	57	64
Total	51	65	54	34	18	29	24	30	179	638	440	379

Figure 8 - Class 9's and 10's by Direction
vs Gross Vehicle Weight

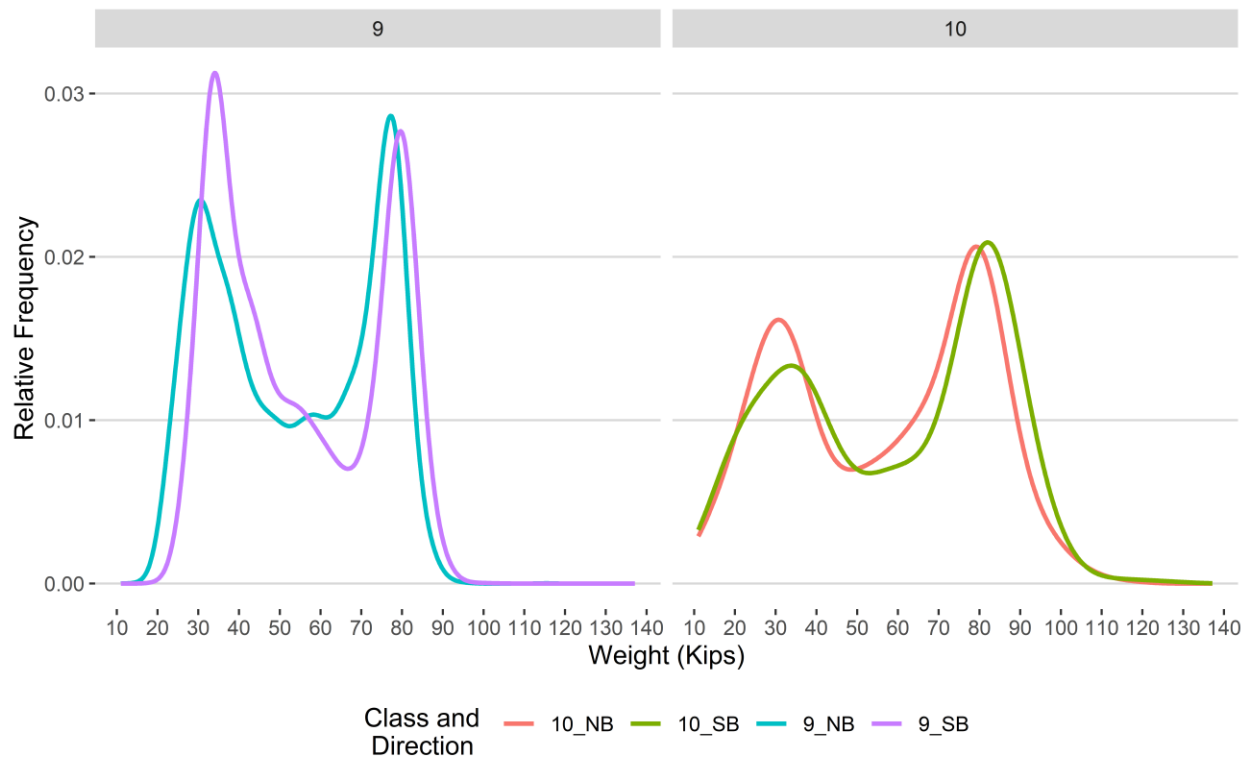


Figure 9 - Freight Percentage
by Direction and Class

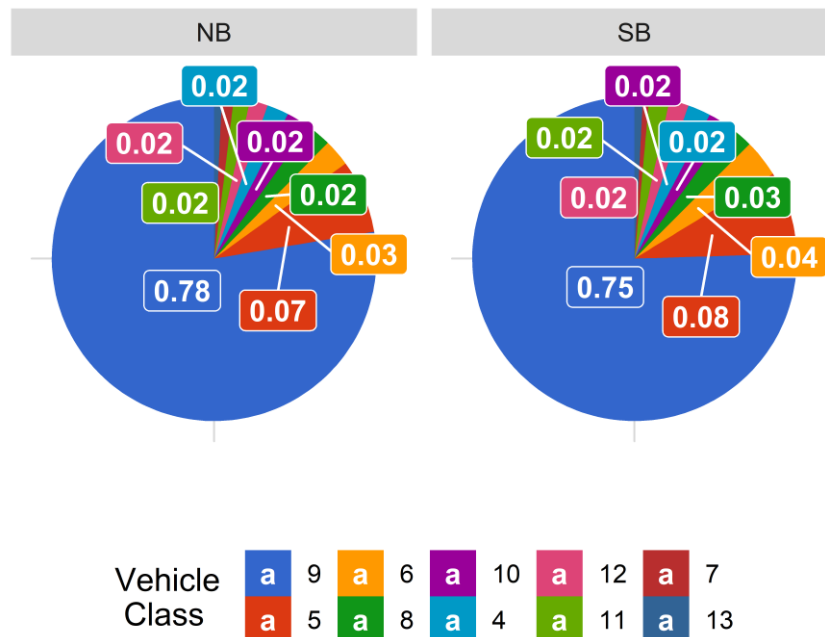


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

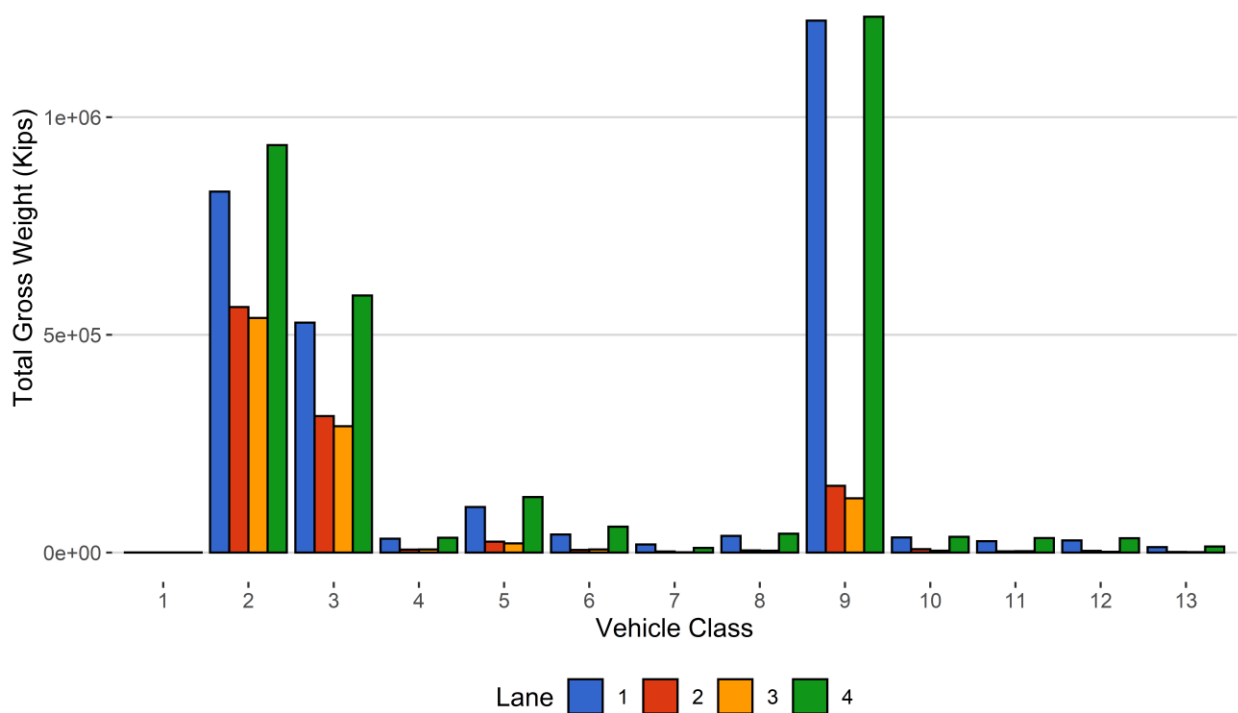


Figure 11 - Total Gross Vehicle Weight t

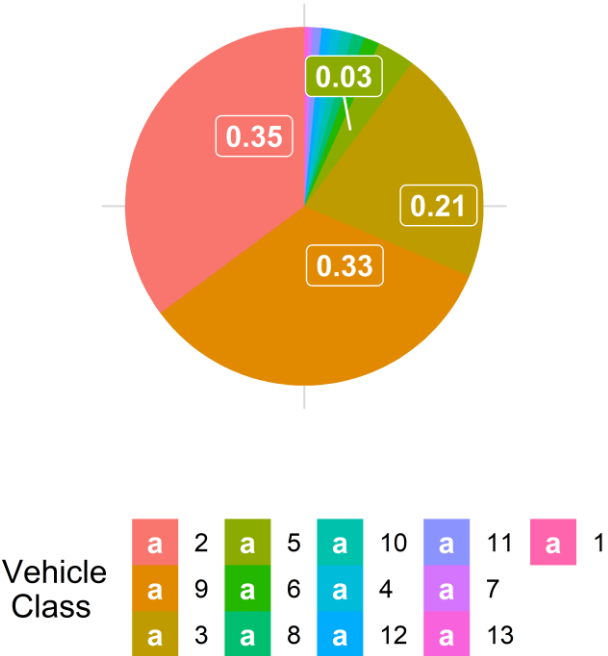


Figure 12 - Total ESALs by Class and Lane

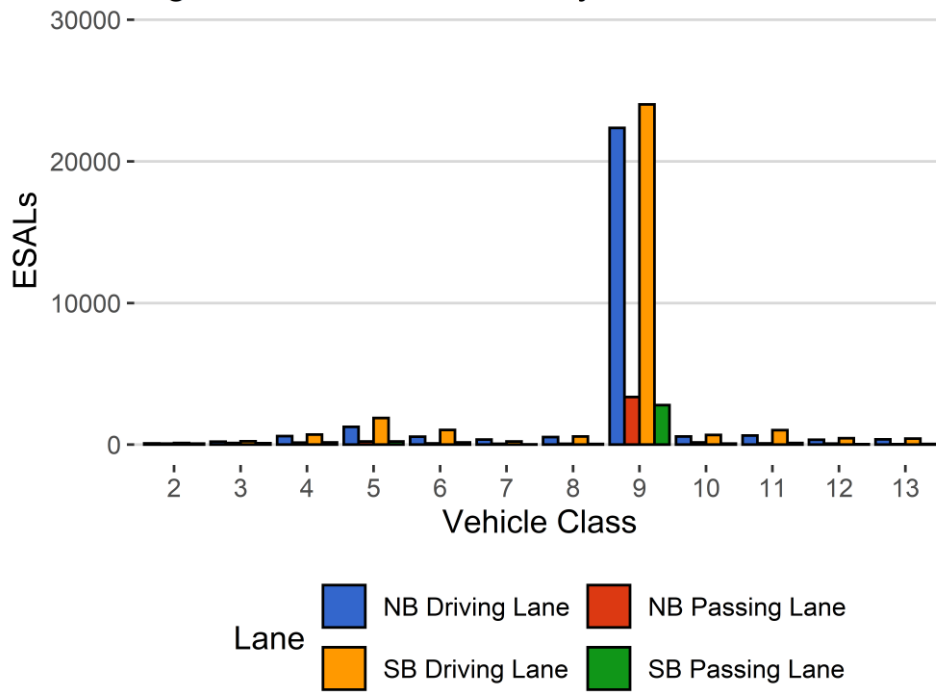


Figure 13 - ESALs by Class

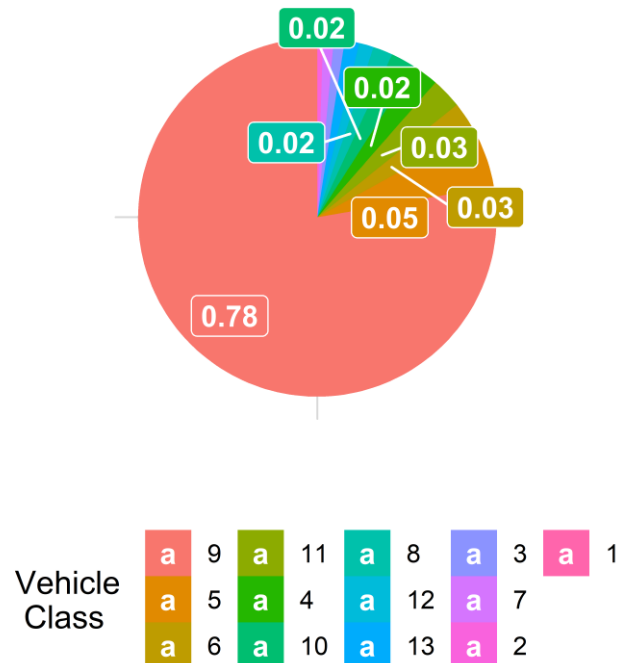


Table 1 Class 9 Front Axle Weight by Lane

<i>Month</i>	<i>Lane 1 (Kips)</i>	<i>Front Axle +/- 9%</i>	<i>Lane 2 (Kips)</i>	<i>Front Axle +/- 9%</i>	<i>Lane 3 (Kips)</i>	<i>Front Axle +/- 9%</i>	<i>Lane 4 (kips)</i>	<i>Front Axle +/- 9%</i>
July 2019	10.23	0.00	11.64	0.00	11.83	0.00	11.75	0.00
August 2019	10.38	1.48	11.65	0.04	11.77	-0.52	11.67	-0.68

Table 2 Vehicle Classification Data

<i>Vehicle Class</i>	<i>Monthly Average Daily Volume</i>	<i>Monthly Total Volume</i>	<i>Monthly Total Volume Percentage</i>	<i>Monthly Total Overweight Vehicles</i>	<i>Monthly Total Overweight Percentage</i>
1	12	367	0	0	0
2	23593	731372	66.7	0	0
3	9045	280400	25.6	0	0
4	82	2551	0.2	180	1.5
5	609	18890	1.7	298	2.6
6	127	3941	0.4	186	1.6
7	17	531	0	171	1.5
8	100	3087	0.3	98	0.8
9	1658	51405	4.7	9777	84.1
10	47	1459	0.1	437	3.8
11	36	1115	0.1	173	1.5
12	37	1142	0.1	57	0.5
13	9	289	0	244	2.1
TOTAL	35373	1096548	100	11621	100

Table 3 Top 10 Gross Vehicle Weight, Class 9 and 10

<i>Date</i>	<i>Day of Week</i>	<i>Time</i>	<i>Vehicle Class</i>	<i>Direction</i>	<i>Lane</i>	<i>GVW (lbs)</i>
2019-08-02	Friday	02:43:06	9	NB	1	137.16
2019-08-22	Thursday	12:45:00	9	SB	4	136.26
2019-08-30	Friday	01:38:57	9	NB	1	132.13
2019-08-19	Monday	06:15:33	10	SB	4	126.35
2019-08-27	Tuesday	02:22:51	9	NB	1	124.75
2019-08-06	Tuesday	03:01:28	9	NB	1	118.33
2019-08-06	Tuesday	10:28:03	10	SB	4	117.19
2019-08-13	Tuesday	03:25:19	9	NB	1	115.93
2019-08-16	Friday	00:17:08	9	SB	3	115.84
2019-08-17	Saturday	15:26:01	9	NB	1	115.68

Table 4 Freight Summary

<i>Vehicle Class</i>	<i>Direction</i>	<i>Weight of Empty Vehicle (Kips)</i>	<i>Total Number of Vehicles</i>	<i>Number of Empty Vehicles</i>	<i>Percentage of Empty Vehicles</i>	<i>Total Weight of Vehicles with Freight (Kips)</i>	<i>Total Weight of Empty Vehicles (Kips)</i>	<i>Total Weight of Freight (Tons)</i>
4	NB	15	1216	118	9.7	36797	1501	10163
5	NB	8	8968	885	9.9	122988	6491	29162
6	NB	19	1711	444	25.9	39990	7365	7959
7	NB	11.5	323	0	0	20787	0	8536
8	NB	31	1482	925	62.4	21697	21500	2215
9	NB	33	25567	5686	22.2	1215542	159735	279734
10	NB	33.5	745	198	26.6	37417	5101	9546
11	NB	36.5	508	24	4.7	27908	672	5121
12	NB	36.5	545	58	10.6	29823	1910	6024
13	NB	31.5	136	0	0	13660	0	4688
TOTAL	****	****	41201	8338	****	1566609	****	363149
<i>Vehicle Class</i>	<i>Direction</i>	<i>Weight of Empty Vehicle (Kips)</i>	<i>Total Number of Vehicles</i>	<i>Number of Empty Vehicles</i>	<i>Percentage of Empty Vehicles</i>	<i>Total Weight of Vehicles with Freight (Kips)</i>	<i>Total Weight of Empty Vehicles (Kips)</i>	<i>Total Weight of Freight (Tons)</i>
4	SB	15	1273	109	8.6	39420	1443	10980
5	SB	8	9463	585	6.2	144145	4275	36560
6	SB	19	2134	237	11.1	62411	4149	13184
7	SB	11.5	195	0	0	11339	0	4548
8	SB	31	1530	720	47.1	30850	16306	2870
9	SB	33	24590	3373	13.7	1253681	101828	276760
10	SB	33.5	679	145	21.4	36806	3474	9459
11	SB	36.5	580	40	6.9	34921	1164	7606
12	SB	36.5	569	7	1.2	34329	211	6908
13	SB	31.5	146	0	0	14954	0	5177
TOTAL	****	****	41159	5216	****	1662855	****	374052
GRAND TOTAL	****	****	82360	13554	288	3229464	337124	737201

Table 5 Gross Vehicle Weight by Class and Lane

<i>Vehicle Class</i>	<i>NB Driving Lane</i>	<i>NB Passing Lane</i>	<i>SB Passing Lane</i>	<i>SB Driving Lane</i>	<i>Total</i>	<i>Percentage</i>
1	140	89	77	161	466	0
2	829128	563855	538993	935949	2867924	35.2
3	528071	313378	290274	590593	1722315	21.1
4	31827	6470	6986	33877	79161	1
5	104592	24887	21090	127329	277899	3.4
6	41549	5806	7126	59433	113915	1.4
7	18536	2252	661	10679	32127	0.4
8	38239	4958	4056	43100	90353	1.1
9	1221959	153318	124546	1230962	2730785	33.5
10	34778	7740	4119	36161	82798	1
11	25957	2623	3024	33061	64665	0.8
12	27879	3854	1694	32846	66272	0.8
13	12424	1236	995	13959	28614	0.4
TOTAL	2915080	1090464	1003640	3148110	8157294	100
GVW/LANE	35.74	13.37	12.3	38.59	100	0

Table 6 ESALs by Class and Lane and Flexible ESAL Factors

<i>Vehicle Class</i>	<i>NB Driving Lane</i>	<i>NB Passing Lane</i>	<i>SB Passing Lane</i>	<i>SB Driving Lane</i>	<i>Total</i>	<i>Percentage</i>	<i>Flexible ESAL Factor</i>
1	0	0	0	0	0	0	0.0028
2	88	69	69	111	338	0.5	0.001
3	203	111	106	240	660	0.98	0.0048
4	609	143	158	711	1621	2.4	1.3
5	1260	224	222	1880	3587	5.31	0.39
6	557	93	161	1043	1854	2.74	0.97
7	364	58	15	222	659	0.98	2.53
8	529	60	42	573	1204	1.78	0.8
9	22355	3363	2798	24016	52533	77.75	2.1
10	571	156	73	684	1485	2.2	2.08
11	637	82	108	1025	1852	2.74	3.38
12	345	70	26	449	890	1.32	1.59
13	373	37	46	428	884	1.31	6.04
TOTAL	27892	4469	3824	31384	67568	100	21
ESALS/LANE	41.3	6.6	5.7	46.4	100	-	-

Table 7 Site Summary: Volume and Vehicle Class

<i>Month</i>	<i>Total Volume</i>	<i>Monthly ADT</i>	<i>Monthly HCAD T</i>	<i>Passenger Vehicles</i>	<i>Passenger Vehicles %</i>	<i>Heavy Commercial Vehicles</i>	<i>Heavy Commercial Vehicles %</i>	<i>Heavy Commercial Vehicles in Driving Lane %</i>	<i>Heavy Commercial Vehicles in Passing Lane %</i>
Sep 2018	975288	32510	2516	899811	92.3	75477.3	7.7	88.6	11.4
Oct 2018	1005115	32423	2741	920135	91.5	84980	8.5	89	11
Nov 2018	807078	31042	2150	742577	92	64501	8	88.3	11.7
Dec 2018	864651	28822	2035	801570	92.7	63081.4	7.3	89.2	10.8
Jan 2019	786295	25364	2059	722455	91.9	63839.9	8.1	88.7	11.3
Feb 2019	682508	24375	2079	624284	91.5	58224	8.5	82.2	17.8
Mar 2019	904406	29174	2268	834104	92.2	70302.3	7.8	88.7	11.3
Apr 2019	922175	30739	2481	847749	91.9	74425.7	8.1	88.3	11.7
May 2019	1039153	33329	2670	956381	92	82771.9	8	87.5	12.5
Jun 2019	1022960	34099	2622	944302	92.3	78658.4	7.7	86.8	13.2
Jul 2019	1058475	34221	2702	974717	92.1	83757.7	7.9	87.2	12.8
Aug 2019	1096548	35208	2723	1012139	92.3	84409.1	7.7	88	12
TOTAL	11164652	-	-	10280224	-	884429	-	-	-
AVERAGE	930388	30942	2420	856685	92	73702	8	88	12

###ESALs

<i>Month</i>	<i>ESALS NB Passing Lane</i>	<i>ESALS NB Driving Lane</i>	<i>ESALS SB Driving Lane</i>	<i>ESALS SB Passing Lane</i>	<i>Total ESALS</i>	<i>Driving Lane ESALS %</i>	<i>Passing Lane ESALS %</i>	<i>Pavement Life Decrease Months</i>
Sep 2018	19416	3002	1725	16380	40523	88	12	1.2
Oct 2018	20621	3073	1569	17666	42930	89	11	1.1
Nov 2018	16547	2620	1352	14453	34973	89	11	1.2
Dec 2018	12208	2206	1054	12749	28217	88	12	0.2
Jan 2019	10858	2006	1055	11960	25880	88	12	0.3

Feb 2019	8685	2828	1545	10833	23891	82	18	0.3
Mar 2019	12211	2429	1320	13607	29567	87	13	0.1
Apr 2019	13454	2771	1525	14186	31936	87	13	0
May 2019	32259	4042	3006	23513	62819	89	11	21.3
Jun 2019	53625	10086	7472	58409	129592	86	14	3.4
Jul 2019	25138	4916	4146	32194	66394	86	14	4.4
Aug 2019	27967	4501	3840	31466	67774	88	12	3.9
TOTAL	252991	44479	29609	257416	584495	-	-	-
AVERAGE	21083	3707	2467	21451	48708	87	13	3

###Gross Vehicle Weight

<i>Month</i>	<i>GVW NB Passing Lane</i>	<i>GVW NB Driving Lane</i>	<i>GVW SB Passing Lane</i>	<i>GVW SB Driving Lane</i>	<i>Total GVW Kips</i>
Sep 18	2508245	912624	761584	2459287	6641740
Oct 18	2663414	939774	748845	2610840	6962873
Nov 18	2335826	846388	669420	2308649	6160283
Dec 18	2086264	770010	604432	2166104	5626811
Jan 19	1876590	646522	520347	1994371	5037829
Feb 19	1423377	652606	530116	1737913	4344012
Mar 19	2086856	798781	620139	2233229	5739005
Apr 19	2203311	844134	673418	2294631	6015495
May 19	2887575	1038509	896554	2762671	7585308
Jun 19	5370351	2138820	1938350	5817580	15265101
Jul 19	2756663	1092970	1018131	3103868	7971633
Aug 19	2918571	1091245	1004179	3150967	8164962
TOTAL	31117044	11772382	9985516	32640110	85515052
AVERAGE	2593087	981032	832126	2720009	7126254

###Overweight Vehicles

<i>Month</i>	<i>Total Number of Overweight Vehicles</i>	<i>Overweight / Total Volume</i>	<i>Overweight / Heavy Commercial Volume</i>	<i>Number Over 88,000 lbs</i>	<i>Number Over 98,000 lbs</i>
Sep 2018	1785	0.2	2.4	138	77
Oct 2018	1564	0.2	1.9	142	95
Nov 2018	1176	0.1	1.6	125	77
Dec 2018	728	0.1	1.1	66	27
Jan 2019	575	0.1	0.9	48	21
Feb 2019	794	0.1	1.4	56	26
Mar 2019	591	0.1	0.9	71	48
Apr 2019	563	0.1	0.8	70	42
May 2019	9712	1	11.9	1831	162

Jun 2019	22320	1.1	14.5	1866	262
Jul 2019	11264	1.1	13.7	645	150
Aug 2019	11662	1.1	14.1	585	149
TOTAL	62734	-	-	5643	1136
AVERAGE	5227.8	0.4	5.4	470.2	94.7

###Freight

<i>Month</i>	<i>NB Freight Tons</i>	<i>SB Freight Tons</i>	<i>Total Freight</i>	<i>NB Freight %</i>	<i>SB Freight %</i>
Sep 2018	289856	250391	540246	53.7	46.3
Oct 2018	321475	280646	602121	53.4	46.6
Nov 2018	261150	229123	490273	53.3	46.7
Dec 2018	207108	197689	404797	51.2	48.8
Jan 2019	191437	189886	381323	50.2	49.8
Feb 2019	161646	180700	342346	47.2	52.8
Mar 2019	217306	218688	435994	49.8	50.2
Apr 2019	239111	230147	469258	51	49
May 2019	377156	315573	692729	54.4	45.6
Jun 2019	693719	700129	1393849	49.8	50.2
Jul 2019	346328	382396	728724	47.5	52.5
Aug 2019	363149	374052	737201	49.3	50.7
TOTAL	3669441	3549420	7218861	-	-
AVERAGE	305786.7	295785	601571.7	50.9	49.1